ELECTRONIC POSTER: CLINICAL TRACK: HEALTH ECONOMICS

EP-1126
FMEA application to prevent clinical risk in radiotherapy
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Purpose/Objective: Aim of our work was the implementation of FMEA (Failure mode and effects analysis). We used the FMEA in the analysis of the process: 'Radiotherapy Treatment', to identify possible errors, consequent effects of them, and to apply improvement suggestions of risk reduction.
Materials and Methods: At the beginning of 2010, at our Radiotherapy Department, a risk management dedicated working group was set up. 'Radiotherapy treatment' was the process chosen for the analysis, *i.e.* the patient's course since the first radiotherapy session till the treatment's end. All the different failure modes, requiring containment actions, were identified and ranked, based on severity (S), occurrence probability (OP), and probability that this particular failure would go undetected (D). Each event was rated to assign a risk probability numbers (RPN), in terms of severity according to Technical Commission of Risk Management scale, and in terms of probability of occurrence and failure according to the JCHAO modified scale, each one on a scale of 1 to 5. The RPN for each failure mode has been identified on a tabulated scores multiplying together the three value of S, OP and D parameters. Before we analyzed a total of 19 different failure modes, and after we reported the RPN for each event in a prioritization matrix divided into risk classes (low, intermediate and high risk). Finally for each failure modes we studied its containment action to be applied to RPN to decrease the risk class.
Results: In our work the seven failure modes, classified in the high risk prioritization matrix, were considered for interventional solutions. The activities were: 1) lack of notes for electron treatments for head and neck cancer, 2) wrong phase sequence planning after treatment stop, 3) exchange of patients at the waiting room call, 4) lack of EPID control, 5) missing control request for the EPID by the technician, 6) collision between the Linac gantry and the patient, 7) lack of planning for the visits during therapy. The containment actions for each failure mode were respectively: 1) reductions in the usage of phases with electrons, 2) planning of one phase at a time, 3) delivery of identification badge, sporting name, surname and treatment sheet number, to show before each session, 4) annotation by the radiation oncologist of all verifications to repeat, 5) double check by the technicians that the EPID control was requested, 6) test of all fields during the first session, with added explanation notes, 7) planning on an electronic calendar of the visits during the therapy. With the application of the containment action we obtained a significant reduction of the risk factor score in all the failure modes considered.
Conclusions: All identified containment actions were introduced by December 2011. At the end of 2012 their efficacy will be measured, by re-evaluation of all indexes based on the occurrences during the year.

EP-1127
Radiotherapy in India: Technology transformation led by economic growth
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Purpose/Objective: The median age in India in 2012 is 26.5 (male 25.9 and female 27.2) where as the life expectancy has grown to 67.14 (male 66.08 and female 68.33). Life expectancy was 31 in 1947, the year India got Independence. With increased life expectancy cancer incidence is on the rise. Healthcare delivery in India has witnessed a sea change in the new millennium. Oncology, especially radiation oncology has made quantum jumps, by way of acquisition of high tech and expensive equipment. A country with a population touching 1.25 billion and now among the top 4 economies of the world India has the potency for many more high end technologies including Particle and Proton therapy facilities. A study of the growth of radiotherapy technology in India in the new millennium is done.
Materials and Methods: India with its colonial history has traditionally been a low-tech and manpower intensive healthcare provider. The new millennium however has brought the new era of reforms and economic development. Recent infusion of technology across the country and paradoxical abilities of making such technologies economically viable in all major disciplines of medicine, be it Cardiac Care or Robotic Surgeries, is noteworthy. In radiotherapy there is several fold addition of equipment with capabilities like 3D CRT, IMRT, IGRT, Stereotactic Body Radiotherapy, Robotic Radiosurgery and Helical Tomotherapy in several centers in various parts of India. The data and trends of growth of each of these technologies in India is studied.
Results: India had its first linear accelerator in 1982 and had its first linear accelerator based dedicated stereotactic radiosurgery in 1996, The total number of linear accelerators remained in single digit till 2000.The first IMRT was delivered in 2001, but the lag between technology adoption narrowed significantly in the later part of the decade. Linear Accelerators grew from 22 in early 2002 to 237 by March 2012, an impressive growth of more than 1000% in a decade. Cobalt units have reduced from 258 in 2003 to 237 in 2012 and many more are being decommissioned. HDR brachy therapy units have grown from 50 in 2003 to 200 in 2012, a fourfold increase. The same is true in diagnostic facilities like the PET-CT scanners and 3T MRI and related equipment. With highly acclaimed competencies in core scientific communities in the field of Nuclear Physics and Nuclear Engineering in place, it is very likely that India will have its own particle therapy facility in this decade itself.
Conclusions: The acquisition of high-end equipment in radiotherapy in India is significant both quantitatively and qualitatively. India is known for its scientific achievements in atomic energy, space sciences, satellite communication, missile technology and information technology (IT). The current trend certainly gives India an edge in healthcare too.The gap of accessibility and affordability however is there and is beyond the purview of the current study. The transformation of Indian health care is real and radiotherapy in India is all set to achieve new heights.

ELECTRONIC POSTER: CLINICAL TRACK: OTHER TUMOUR SITES

EP-1128
Prevention and treatment of acute radiodermatitis with Water Jel R1 and R2
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Purpose/Objective: The radiodermatitis is the most frequent reaction during the accomplishment of external beem radiotherapy. Clinicaly radiodermatitis is manifested with appearance of erythema, dry and moist desquamation. Its prevention and treatment are necessary for the aim of accomplishing the planned therapeutic dose.
Materials and Methods: In the Clinic of Radiotherapy within the National Hospital of Oncology for the period March – July 2012, prevention and treatment was carried out of acute radiodermatitis with Water Jel R1 and R2 on 30 patients. In 27 of the cases, the preparations were applied after the appearance of the radiodermatitis 1st degree as per CTCAE v. 4. This usually occurs after realization oftotal dose of 30-36Gy, and in 3 of the patients for prevention from radiodermatitis from the beginning to the end of the radiotherapy. The patients from the first group suffer from carcinoma in the head and neck area and are undergoing definitive radiotherapy or chemo-radiotherapy treatment, the three patients from the second group - carcinoma in the mammary gland and undergoing postoperative radiotherapy.
Results: Affecting the symptoms of the radiodermatitis, such as pain, dryness and erythema has been observed immediatly after the first application of the two products Water Jel R1 and R2.
In two of the patients with carcinoma in head and neck, after the application of the preparations, the realization of surdosage for the field of the primary tumor up to 70Gy became possible, without discontinuing the radiotherapy after 60 Gy. In patients for whom preventive treatment has been performed with Water Jel R1 andR2 appearance of radiodermatitis 1st degree was not observed at all, but only slight pigmentation at the end of the radiotherapy.
Conclusions: The application of the two preparations Water Jel R1 and R2 is: easy and convenient for the patients, as the subjective complaints are being influenced (such as pain, dryness and erythema) as well as the comfort during the radiotherapy is improved. The improvement of the tolerance towards the treatment is present and at the same time the discontinuation due to appearance of radiodermatitis of 2nd and 3rd degree is avoided, whereas no side effects are observed. In the clinical practice these preparations can

successfully be used for prevention and treatment of acute radiodermatitis.

EP-1129

Radiotherapy for mucosa-associated lymphoid tissue lymphoma of the ocular adnexa

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Purpose/Objective: Radiotherapy is useful for the treatment of MALT lymphoma of the ocular adnexa and is the first choice for this disease. We investigated the long-term follow-up results of radiotherapy for MALT lymphoma of the ocular adnexa.
Materials and Methods: Twenty-four patients with MALT lymphoma of the ocular adnexa were treated with radiotherapy alone. The disease arose from the conjunctiva in 18 patients (10 with bilateral involvement), and from the retrobulbar space in 6 patients (1 with bilateral involvement). The median follow-up of the surviving patients was 70 months (range, 6-157). The histological diagnoses obtained via an incisional biopsy in all cases were categorized according to the criteria established by the WHO classification. During the staging work-up, gallium scans, computed tomography of the chest and abdomen, and FDG-PET were performed for all patients. Patients with I_{AE} or I_{AE2} disease according to the American Joint Committee on Cancer TNM Classification were treated with radiotherapy alone. Lesions confined to the conjunctiva were treated with a single anterior direct field using a 6-12 MeV electron beam. The entire bulbar and palpebral conjunctiva were treated. Retrobulbar tumors were irradiated with 18 MeV electron or 6-MV X-rays. The clinical target volume was the entire orbital cavity. A median dose per fraction of 2.0Gy (range 1.8-2.5) was administered, with the total dose ranging between30 and 54Gy (median, 38Gy). Lead eye shields were used for radiotherapy of conjunctival lymphoma. Lens protection was not used for radiotherapy of retrobulbar lymphoma except for one patient.
Results: All patients with MALT lymphoma achieved a CR or unconfirmed CR (CRu). Two patients died of other disease. One patient died of lung cancer and another patient died of progressive supranuclear palsy. The 5-and 10-year overall survival rates of all patients with MALT lymphoma were 100% and 90%, respectively. The 5-and 10-year cause-specific survival rates were 100% and 100%, respectively. Seven eye-balls developed delayed toxicity. Four eye-balls with conjunctival lymphoma experienced dry eye syndrome, and four eye-balls developed cataracts. One patient with retrobulbar lymphoma experienced both dry eye syndrome and cataracts. The vision of patients with cataracts was restored by surgery. In seven eye-balls, the radiation dose had been 40Gy or more.
Conclusions: Excellent local control and survival can be achieved for patients with MALT lymphoma of the ocular adnexa using radiotherapy alone. As a dose of more than 30Gy develops dry eye syndrome or cataract, the dose must not exceed 30Gy for safe treatment of MALT lymphoma of the ocular adnexa. At present, based on our study and previous studies, we administer a radiation dose of 30.6Gy with a fraction size of 1.8Gy for MALT lymphoma of ocular adnexa treatment.

ELECTRONIC POSTER: PHYSICS TRACK: BASIC DOSIMETRY AND PHANTOM AND DETECTOR DEVELOPMENTS/CHARACTERISATION

EP-1130

Determination of the effective point of measurement for parallel plate and cylindrical ionization chambers

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Purpose/Objective: The presence of an air filled ionization chamber in a surrounding medium introduces several fluence perturbations in high energy photon and electron beams which have to be accounted for. One of these perturbations, the displacement effect, may be corrected in two different ways: by a correction factor p_{dis} or by the application of the concept of the effective point of measurement (EPOM). The latter means, that the volume averaged ionization within the chamber is not reported to the chambers reference point but to a different point, the so called effective point of measurement.
Materials and Methods: Within this study the EPOM was determined for four different parallel plate and two cylindrical chambers in mega voltage electron beams using Monte Carlo simulations. The positioning of the chambers with this EPOM at the depth of measurement results in a largely depth independent residual perturbation correction.
Results: For all parallel plate chambers the EPOM is independent on the energy of the primary electrons. Whereas for the Advanced Markus chamber the position of the EPOM coincides with the chambers reference point, it is shifted for the other parallel plate chambers several tenths of millimeters downstream the beam direction into the air filled cavity. For the cylindrical chambers there is an increasing shift of the EPOM with increasing electron energy. This shift is in upstream direction, i.e. away from the chambers reference point toward the focus. For the highest electron energy the position of the calculated EPOM is in fairly good agreement with there commendation given in common dosimetry protocols, for the smallest energy the calculated EPOM positions deviates about 30% from this recommendation.
Conclusions: Besides the determination of the EPOM, the residual perturbation correction for all investigated chambers for the whole range of clinical used electron energies was calculated. The application of the proposed effective point of measurement will increase the accuracy of calculating depth dose data from measured depth ionization curves, especially for depth beyond the reference depth.

EP-1131

Octavius 4D 1000 SRS, a new instrument for SBRT VMAT IMRT verification. Commissioning and clinical implementation

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Purpose/Objective: Modulated arc therapy is becoming the common technique to deliver Stereotactic Radiotherapy. A double challenge arises with respect to its verification. Not only a dose plane should be measured but preferably the entire 3D dose distribution. And, since it includes steep gradient regions, this dose distribution should be obtained with a spatial resolution as high as possible. The aim of this study is to commission a new system which facilitates this procedure, and to evaluate the routine use of this new measuring device.
Materials and Methods: Recently, a new approach to the measure of the 3D dose distribution arised with the introduction of the new Octavius 4D system (PTW). It consists of an ion chamber array embedded in a cylindrical phantom. The phantom is connected to an inclinometer that is attached to the gantry, so that the system is capable to rotate following the gantry orientation in such a way that the array is always perpendicular to the beam axis. Dose distribution and gantry angle are registered as a function of time. Provided with a set of percentage depth dose curves, previously measured and introduced in the system software, the system computes the dose distribution for each gantry angle and reconstructs the resulting 3D dose matrix. The system allows several options for the ion chamber array: the well-known 2D-Array seven29; its successor Octavius Detector 729; or the small field dedicated Octavius 1000 SRS array, which was used in this study, with 977 liquid filled, 2.3×2.3×0.5 mm^3 sized ion chambers covering a 11×11 cm^2 area, with a 2.5 mm spacing in the central 5.5×5.5 cm^2 region. The accelerators used were Varian Clinac iX and Varian TrueBeam with MLC 120HD. The TPS was Eclipse (version 10.0). The commissioning measurements consisted of the following tests: (1) Homogeneity of chamber response evaluated as the maximum deviation with respect to the mean for a uniform field; (2) Linearity, evaluated by fitting measured dose versus UM with a linear function; (3) Reproducibility, evaluated as the maximum difference between several measures with respect to the mean, for the same UM value; (4) Leakage current, pre- and post-irradiation; (5) Verification of typical SBRT clinical plans, evaluated by comparing TPS-calculated versus measured dose using 3D gamma index, with 3%, 3 mm criteria.
Results: (1) The homogeneity between chambers was 0.8%. (2) Linearity was found to be excellent, with an r^2 value better than 0.999. (3) The reproducibility was found to be 0.08%. (4) Leakage increases with previously measured dose and shows its largest variation for large fields. For a 10×10 cm^2 field, it ranges from –0.35 cGy/h to 1.18 cGy/h. (5) Verification of typical clinical plans showed a mean pass ratio of 94.6% (range 91.8%-96.4%).
Conclusions: Octavius 4D system together with Octavius 1000 SRS array is an adequate tool in the routine patient-specific QA of SBRT VMAT IMRT treatment plans.